Framework for the Interoperability of Software Engineering Metamodels

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Declaration

This is to certify that this thesis comprises my original work toward the Doctor of Philosophy degree and due acknowledgement has been made in the text of all other materials used. The work has not been submitted previously, in whole or part, to qualify for any other academic award. Any editorial work, paid or unpaid, carried out by a third party is acknowledged.

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Dedicated to my mother. At her knees my education commenced and to her I owe all that I am or hope to be.

Abstract

A model, represented as a concrete artefact, is an abstraction of reality according to a certain conceptualization. A model can support communication and analysis about relevant aspects of the underlying domain. A model must be expressed in some language and such languages are defined using metamodels. Many metamodels have been proposed and used in the software engineering literature. Some define modelling languages that are general in nature but the literature of modelling is dominated by domain-specific modelling languages or metamodels. Most of these metamodels have been developed independently from each other and any shared concepts are only accidental. Widespread adoption of these metamodels is hindered by differences between metamodels' concepts. Using more than one modelling language during software development requires some sort of interoperability between the metamodels of those modelling languages. This interoperability is also required to allow mappings between models developed using different modelling languages.

These metamodels are not static in nature and are continuously evolving. This evolution has increased their size and complexity over time. This complexity increases when more than one metamodel is used

during software development. Interoperability of a pair of metamodels can reduce their joint size and complexity (elaborated in detail in Chapter 7). The need for interoperability between metamodels is also raised by many research communities.

In this thesis, we have developed a framework that can be used for metamodel interoperability. The framework compares metamodel elements based on their syntax, semantics and structure. The semantics of metamodel elements are further investigated for *linguistic* and *ontological* semantics.

Since terms such as *interoperability*, *bridging*, *merging* and *mapping* have all been used, often loosely, with reference to metamodel compatibility, we will define these terms under the generic term *harmonization*.

Metamodels share some similarities with other domains, e.g. ontologies and schemas. In this thesis, we have also explored the techniques available in these domains that might be useful for metamodel interoperability. We have applied our framework to different metamodels and have shown how metamodels can be used in an interoperable fashion.

The results achieved are analysed and we have shown how interoperability of metamodels can reduce their size and their joint complexity, hence making them easier to understand and use.

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Publications

Publications arising from this thesis.

1. Qureshi, M. A. (2011), Interoperability of software engineering metamodels. InProceedings of the 2011th international conference on Models in Software Engineering(MODELS'11), Jorg Kienzle (Ed.). Springer-Verlag, Berlin, Heidelberg, 12-19.

2. Henderson-Sellers, B., Qureshi, M. A., and Gonzalez-Perez, C. (2012). Towards an interoperable metamodel suite: Size assessment as one input. International Journal of Software and Informatics, 6(2):111124.

3. Qureshi, M. A. (2012), Interoperability of software Engineering Metamodels: Lessons Learned., inUlrich W. Eisenecker and Christian Bucholdt, ed., Software Language Engineering (Doctoral Symposium), CEUR-WS.org, pp. 3-10.

Contents

List of Figures

List of Tables